Heteropoly acid catalysts for the synthesis of fragrance compounds from biorenewables: isomerization of limonene oxide

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Supplementary Information

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Catalyst characterization data

Fig. S1. $^{31}$P MAS NMR spectrum for 20%H$_3$PW$_{12}$O$_{40}$/SiO$_2$.

Fig. S2. XRD patterns for H$_3$PW$_{12}$O$_{40}$ (1) and 20%H$_3$PW$_{12}$O$_{40}$/SiO$_2$ (2).

The acid properties of the catalysts under study (H$_3$PW$_{12}$O$_{40}$, H$_3$PW$_{12}$O$_{40}$/SiO$_2$ and Cs$_{2.5}$H$_{0.5}$PW$_{12}$O$_{40}$) have been discussed in detail elsewhere,\textsuperscript{35,36} including the number and the nature of acid sites and their strength.
Product characterization data

Fig. S3. Mass spectra of compounds 2a, 2b, 3, 4, 5 and 6 (the structures are shown on Scheme 1).
Fig. S4. $^1$H and $^{13}$C spectra of compound 2a.
Fig. S5. $^1$H and $^{13}$C spectra of compound 2b (the solution also contains 2a: $2a/2b \approx 1/2$).
Fig. S6. $^1$H and $^{13}$C spectra of compound 3.
Fig. S7. $^1$H and $^{13}$C spectra of compound 4.